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Carmon, Jr.

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[54] **PLATING BARREL DOOR APPARATUS**

[75] Inventor: **Lawrence J. Carmon, Jr.**, Rocky River, Ohio

[73] Assignee: **Singleton Corporation**, Cleveland, Ohio

[21] Appl. No.: **877,808**

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[51] **Int. Cl.**[4] **B65D 43/20**

[52] **U.S. Cl.** **220/345;** 366/347; 220/346

[58] **Field of Search** 220/345, 346; 366/234, 366/347; 204/213; 49/40, 41

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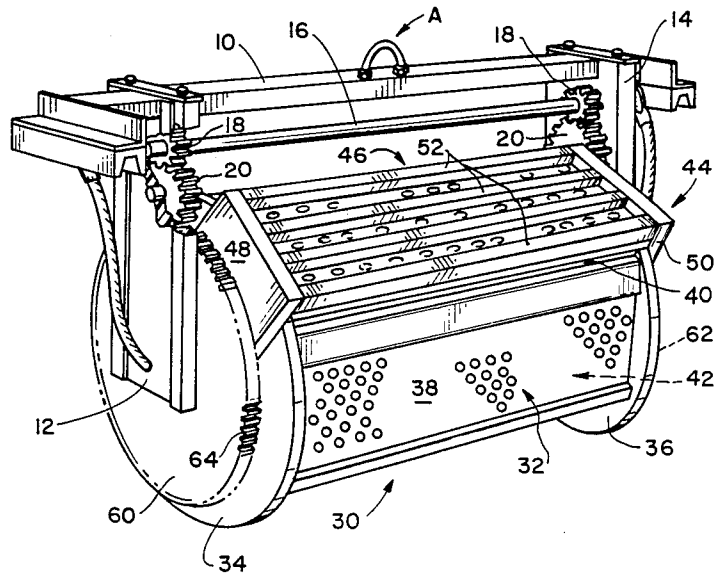
Primary Examiner—George T. Hall

Attorney, Agent, or Firm—Fay, Sharpe, Beall, Fagan, Minnich & McKee

[57] **ABSTRACT**

A rotatable container assembly for use in surface treatment of particulate workpieces includes a container having opposed head ends and a side member defining a work cavity therein. An aperture is formed in a minor portion of the side member and a door arranged for opening and closing relation with the aperture. Means for imparting generally arcuate movement and generally radial movement advances and retracts the door between open and closed positions. Preferably, the movement imparting means includes a cam slot and cam follower arranged between a driven gear and a closely adjacent end plate. Push blocks assist in selective rotation of the container both relative to and with the door. Plural locking slots are arranged on the periphery of the end plate for operative engagement with a lock member extending from the gear.

29 Claims, 5 Drawing Sheets



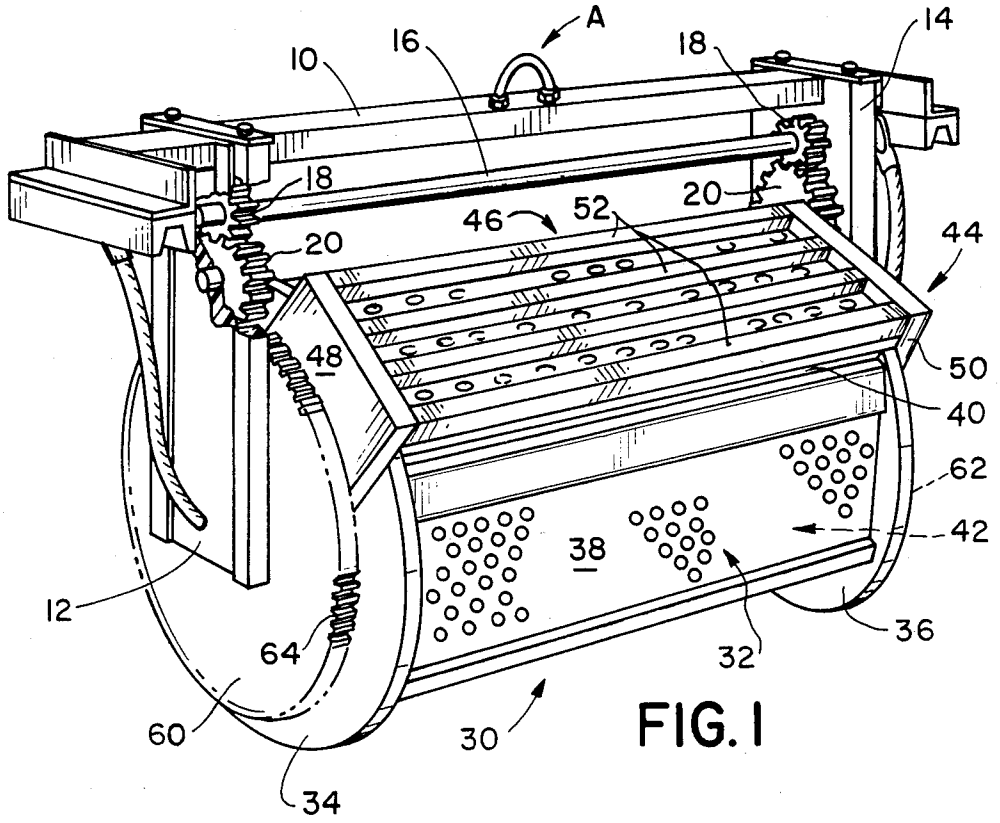


FIG. 1

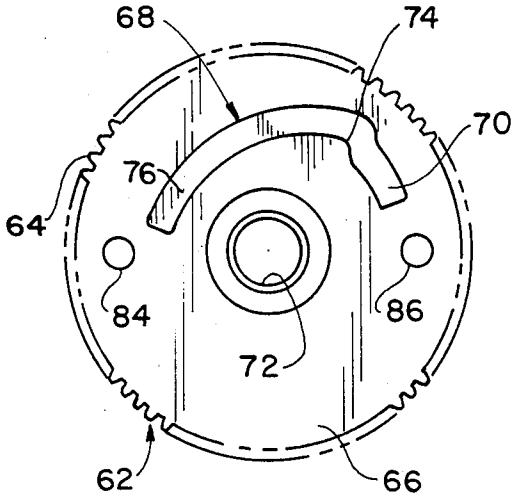


FIG. 2

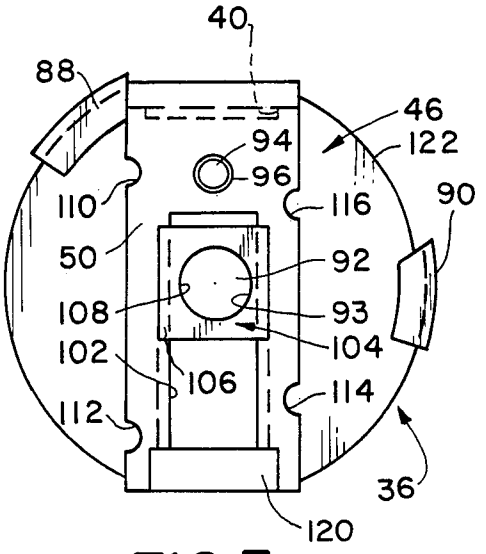


FIG. 3

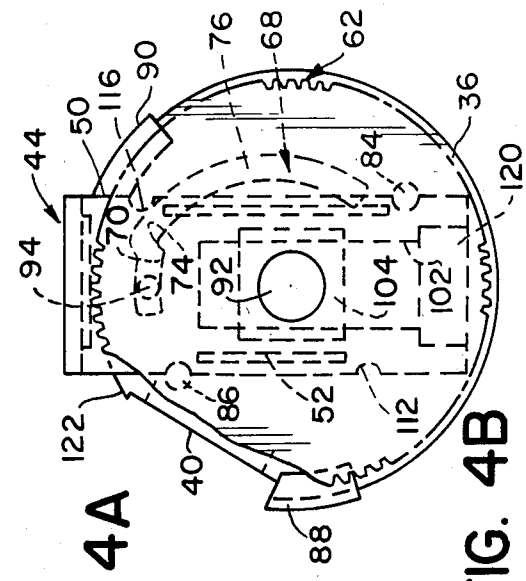


FIG. 4B

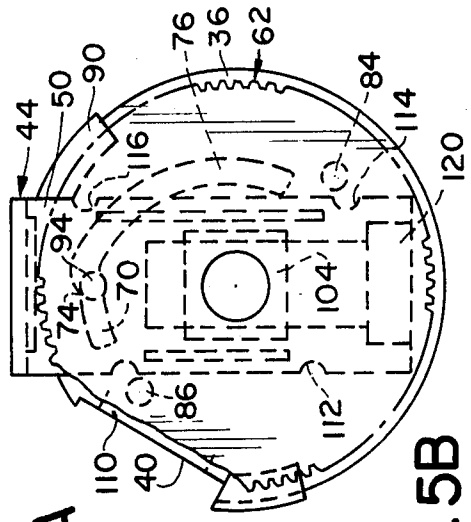


FIG. 5B

FIG. 4A

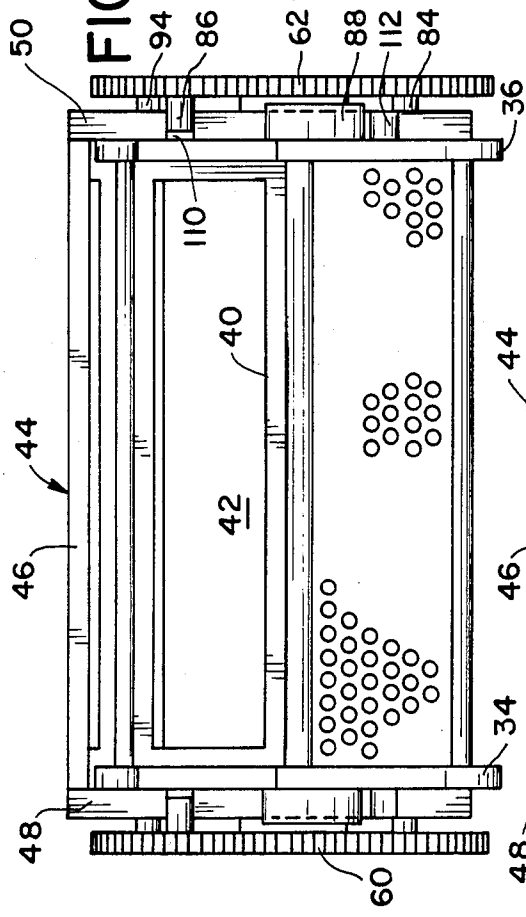
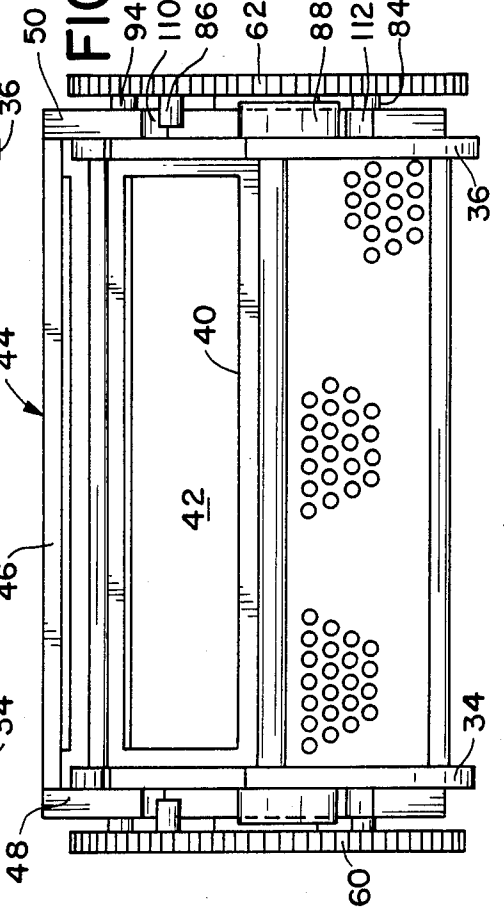


FIG. 5A



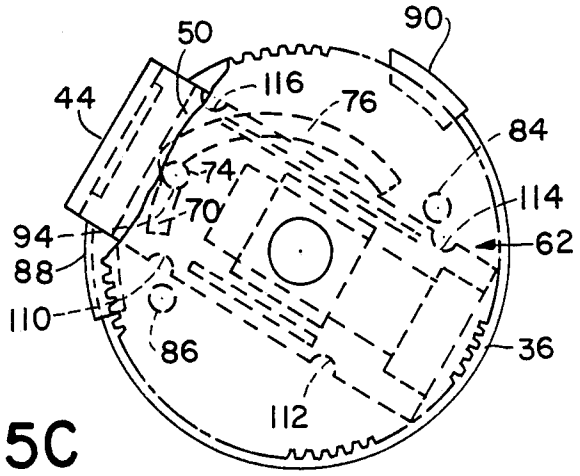


FIG.5C

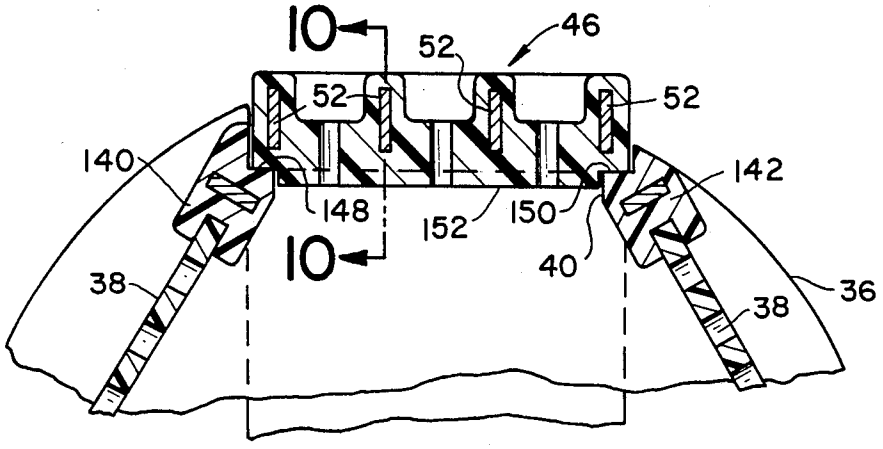


FIG. 9

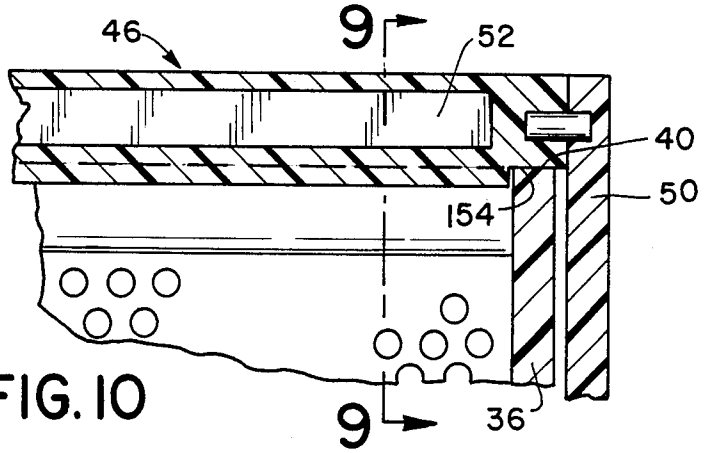


FIG. 10

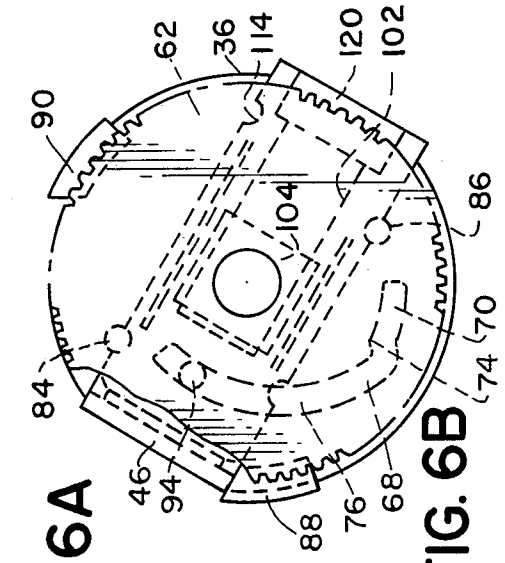


FIG. 6B

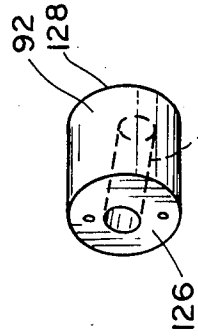


FIG. 8

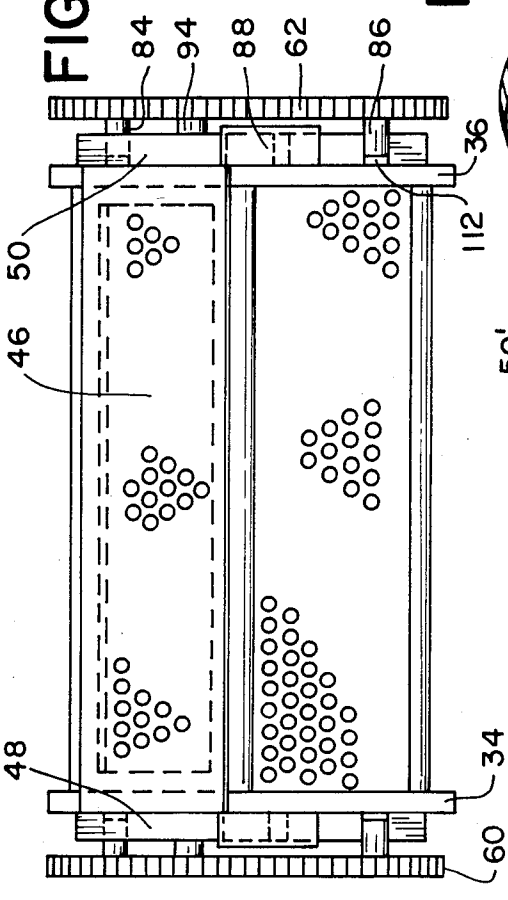


FIG. 6A

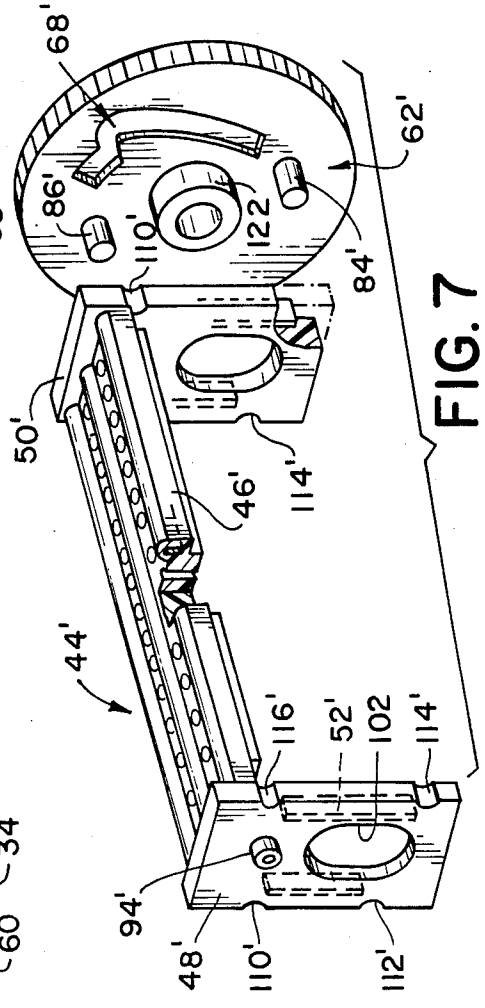


FIG. 7

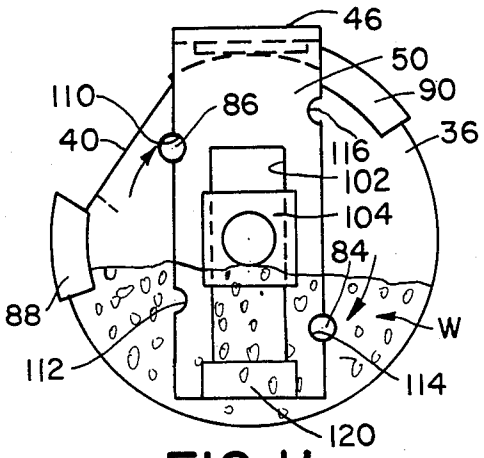


FIG. 11

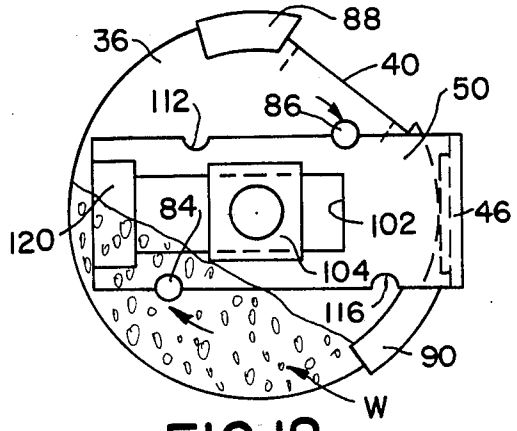


FIG. 12

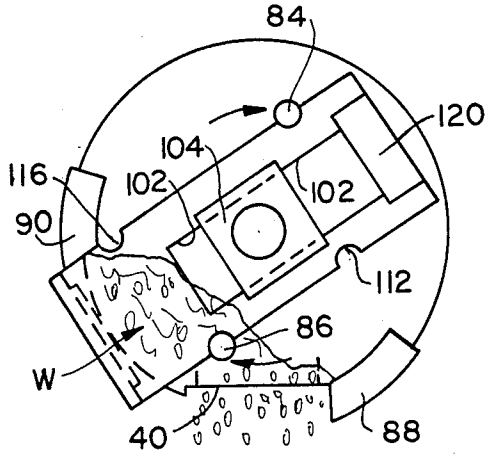


FIG. 13

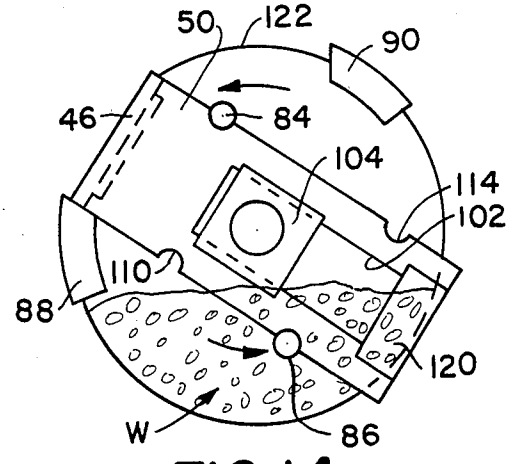


FIG. 14

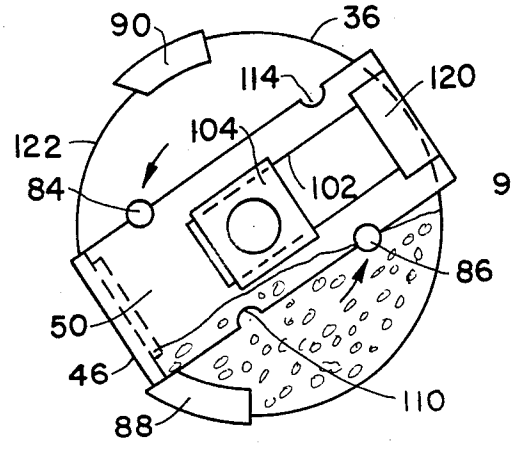


FIG. 15

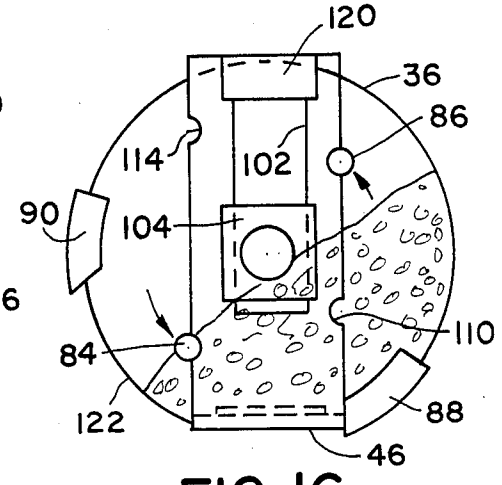


FIG. 16

PLATING BARREL DOOR APPARATUS

BACKGROUND OF THE INVENTION

The present invention pertains to apparatus for treating articles of manufacture in a fluid. More particularly, the invention relates to doors and closures for treatment containers or barrels which are adapted to be disposed in a tank of treating fluid.

The invention finds particular application in the art of electroplating and will be described with particular reference thereto. However, it is to be appreciated that the invention is also applicable for cleaning, phosphating, rinsing and other treating operations.

A conventional plating barrel is filled with particulate workpieces or items to be plated or treated and immersed in an electroplating or other highly corrosive treating fluid. The barrel is rotated within a tank of treating fluid whereby the treated items cascade over each other in the interior of the barrel. The barrel interior is typically filled approximately one-third to one-half its capacity and generally holds workpieces collectively weighing over one hundred pounds and, on certain occasions, holding workpieces collectively weighing as much as five hundred pounds or more. The barrels must be sufficiently durable and are constructed of a material adapted to withstand the usually corrosive effects of the treating fluid. Selected plastics have been used with commercial success.

The barrel has a generally circular sidewall and a pair of opposed flat head ends or endwalls defining a work cavity therein. Oftentimes, the cylindrically shaped barrel is formed of a plurality of panel members arranged in a hexagonal or octogonal relationship and weldingly secured to the heads. One of the panels is left out of the welded arrangement and adapted or modified for selective removal and thereby function as a door. The removable panel provides ingress and egress to the interior work cavity. Due to the extreme weight and various workpiece sizes subject to the treating process, a secure and close fitting arrangement is required between the door and the remainder of the barrel. The enclosure mechanism which holds the door closed must be sufficiently strong to withstand the weight of the cascading workpieces contained therein, sufficiently corrosion resistant to withstand the treating fluids, and easy to operate.

By way of example, U.S. Pat. No. 2,886,505, is issued May 12, 1959 to Singleton, et al. illustrates a conventional clamping arrangement for holding a door in a closed position. As is evident, the door is substantially similar to the remaining panels defining the sidewall of the generally cylindrical container. Still other clamping arrangements are illustrated in U.S. Pat. No. 912,041 to Snow and U.S. Pat. No. 2,845,979 to Lupo. Both of these patents require direct operator assistance in fastening and clamping the door in fixed, covering relation with the aperture and the remainder of the barrel. U.S. Pat. Nos. 3,507,529 and 3,583,739 issued Apr. 21, 1970 and June 8, 1971, respectively, to Gill are both directed to a door assembly for a plating barrel. Although applicable to use of automated machinery in lifting the door from the barrel, these arrangements necessarily require manual operator assistance to unfasten or remove the door from the opening. Even if adaptable to fully automated operation, the peripheral machinery necessary to unfasten and remove these doors from a barrel would be extremely complex and cost prohibitive.

One type of "hands-off" automatic door opening and closing apparatus for a barrel is exemplified in U.S. Pat. No. 3,861,654 issued Jan. 21, 1975 to Singleton. The door is designed for an arcuate movement between predetermined stop limits defining the door open and door closed postions. The type of structure illustrated by this patent has met with success. Nevertheless, it has been considered desirable to retain the benefits of a door which is recessed radially into the opening, as in the manual door arrangement, to prevent inadvertent sliding or falling out of the workpieces retained in the working cavity.

By way of example, electroplating small workpieces such as washers or the like requires close tolerances to be maintained between the door and aperture. If a washer were to become lodged between the edge of the door and the remainder of the container, the washer would fail to be properly electroplated or escape from the container. An increased focus on quality control could potentially lead to rejection of a large number of workpieces under such a scenario.

The present invention contemplates a new and improved door opening and closing apparatus for treatment barrels which provides an automatic "hands-off" operation along with the benefits of a close fitting recessed door arrangement.

SUMMARY OF THE INVENTION

According to the present invention, a simplified and economical automatic door assembly is provided for a treatment barrel or the like.

According to the invention, a rotatable barrel or container assembly comprises a container having opposed head ends and an aperture formed in a sidewall of the container for access to a work cavity defined therein. A door is adapted for opening and closing the aperture and means for imparting generally arcuate movement and generally radial movement to advance and retract the door is provided.

According to another aspect of the invention, the movement imparting means includes a cam slot and cam follower arrangement.

According to a further aspect of the invention, the door includes means for allowing a generally radial movement thereof while remaining operatively connected to the container.

According to yet another aspect of the invention, the door includes an end plate extending generally perpendicularly from a longitudinal portion of the door. The endplate includes an elongated cut-out adapted for sliding engagement with a trunnion operatively associated with the container.

According to a still further aspect of the invention, locking means are provided to selectively maintain the door in a locked open or closed position.

According to another aspect of the invention, a pair of push blocks are provided and adapted for engagement with the door to selectively rotate the container with the door.

The principal advantage of the subject invention is found in the simplified actuating mechanism for the door.

Another advantage of the invention resides in the adaptability and compatibility with existing automatic and manual manufacturing processes.

Yet another advantage of the invention resides in the automatic "hands-off" control of the door and resultant safety features associated therewith.

Yet another advantage of the invention is found in the reduced labor costs of manufacturing and operation of the container assembly.

Still other advantages and benefits of the invention will become apparent to those skilled in the art upon a reading and understanding of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may take physical form in certain parts and arrangements of parts, a preferred embodiment of which will be described in detail in this specification and is illustrated in the accompanying drawings which form a part hereof and wherein:

FIG. **1** is a perspective view of a rotatable container assembly and drive means and support structure associated therewith as contemplated by the subject invention;

FIG. **2** is an interior end view of an interior face of a gear used in accordance with the subject invention;

FIG. **3** is an end view of the container, particularly illustrating an end plate portion of the door in cooperating relation with a pair of push blocks;

FIG. **4A** is a front elevational view of the rotatable container assembly with the door in a fully open position;

FIG. **4B** is a end view of the right-hand end of FIG. **4A** particularly illustrating the orientation of the door and gear;

FIG. **5A** is a front elevational view of the rotatable container assembly with the door in an intermediate position;

FIG. **5B** is a end elevational view of the right-hand end of FIG. **5A**;

FIG. **5C** is a end elevational view of the right-hand end of FIG. **5A** at a further point in the door movement;

FIG. **6A** is a front elevational view of the rotatable container assembly particularly showing the door in a closed position;

FIG. **6B** is a end elevational view of the right-hand end portion of FIG. **6A**;

FIG. **7** is a perspective view of a modified door and gear in accordance with the subject invention;

FIG. **8** is a perspective view of a trunnion member used in accordance with the subject invention;

FIG. **9** is a cross-sectional view along the lines **9—9** of FIG. **10**;

FIG. **10** is a cross-sectional view along the lines **10—10** of FIG. **9**; and,

FIG. **11–16** generally illustrate the interacting forces in maintaining the door in an open or closed position.

DETAILED DESCRIPTION OF THE PREFERRED AND ALTERNATE EMBODIMENTS

Referring now to the drawings wherein the showings are for purposes of illustrating the preferred and alternate embodiments of the invention only and not for purposes of limiting same, the FIGURES show a support structure A that supports a container assembly B which is commonly referred to as a treatment or plating barrel assembly. The support structure A is adapted to be supported across a tank or bath of treating solution (not shown) or a series of treating tanks if so desired. The container assembly is selectively immersed in the treating tank for treatment of workpieces retained in the container assembly. Further discussion of the overall plating process is deemed unnecessary to a complete understanding of the invention.

More particularly and with reference to FIG. **1**, the support structure A includes an elongated channel member **10** which is connected at its ends to downwardly extending legs **12, 14**. A drive means such as an electric motor or the like (not shown) is adapted to drivingly engage drive shaft **16** and drive gear **18** disposed adjacent the ends thereof. An idler gear **20** is interposed between the drive gear **18** and a driven gear which will be described in greater detail below. As will be readily understood by one skilled in the art, the identical drive gear and idler gear arrangement arranged at the opposed end of the container assembly provides simultaneous, synchronized drive of the assembly at opposed ends. Also, alternative drive means may be employed without departing from the scope and intent of the subject invention.

A container, such as a barrel or drum **30**, includes a generally cylindrical sidewall **32** extending longitudinally between spaced end members or head ends **34, 36**. The sidewall may be formed as a continuous structure or, preferably, is formed from a plurality of planar members **38** arranged in a hexagonal or octogonal relationship. The term "generally cylindrical container" will be understood to include any of these defined structural relationships. The container is rotatably supported between hanger arms **12** and **14** and extends in generally parallel relation with the channel member **10**. The sidewall **32** is preferably of perforated construction to allow treatment fluid to readily pass through the sidewall and, if used for electroplating, allow electrical current flow.

An aperture or opening **40** is defined in a minor portion of the sidewall **32**. In the planar panel arrangement, one of the panels is removed or left out of the structure to define the aperture **40**. The aperture provides ingress and egress to a work cavity or central chamber **42**. The aperture is of sufficient size to easily accommodate insertion and removal of the workpieces into the work cavity **42**. In fact, in the preferred embodiment the aperture comprises approximately 1/6 of the total surface area of the container, although other dimensions and ratios can be used with equal success.

A door **44** includes an elongated portion **46** and a pair of radially extending end plates **48, 50**, as further illustrated in FIG. **3**. The elongated portion **46** is designed to completely cover the aperture in a closed position while the end plates **48, 50** are disposed axially outward of the head ends **34, 36** for close fitting relation therewith. The elongated portion **46** of the door may include longitudinally extending strengthening members **52**, such as steel or the like, that are encapsulated within the plastic material of the door when corrosive solutions are involved. The strengthening members **52** enhance the rigidity of the door.

With further reference to FIGS. **2** and **3**, the actuating mechanism for positioning the door in an open position away from aperture **40** and a closed position substantially covering the aperture will be further described. A driven gear **60** is disposed at one end of the container **30**. As indicated above, a similar driven gear **62** is operatively disposed at the other end of the container. Therefore, the numerals and description of the various elements and relationships of driven gear **62** will apply equally to driven gear **60** unless particularly noted otherwise. The gear **62** has peripherally arranged

drive teeth **64** adapted for meshing engagement with peripheral teeth on idler gear **20**.

An interior face **66** of the gear **62** is disposed in facing relation with the head end **36** of the container while the interior face of gear **60** is in facing relation with head end **34**. The interior face **66** of the gears is clearly illustrated in FIG. **2**. It includes a cam slot or groove **68** having a predetermined pattern. A first portion of the cam slot defines an arcuate length **70** at a generally constant radius from a central opening or mounting aperture **72**. A crest portion **74** is interposed between the constant radius portion **70** and a radially varying portion **76**. The crest portion **74** defines a path that extends radially outward from the constant radius portion while the radially varying portion defines a sloping path that spirals inwardly toward mounting aperture **72**.

The drive gear **62** also includes first and second push dogs or door locks **84, 86**. The precise function of the combination push dogs/door locks will be described in further detail hereinbelow.

With particular reference to FIG. **3**, a view of the cylindrical container head end **36** and a door end plate **50** is illustrated. The head end **34** and door end plate **48** disposed at the left hand portion of the container in FIG. **1** will be of identical construction and function in a similar manner as head end **36** and end plate **50** unless noted otherwise. The head end is of generally circular configuration and includes first and second push blocks **88, 90** extending axially outward therefrom. The push blocks **88, 90** are arranged adjacent a peripheral portion of the head end **36** and positioned at a preselected angular configuration adapted to accommodate the door open and door closed positions as will become more apparent below. A central hub or trunnion **92** is closely received through the head end **36** through a central aperture (not shown) and the external surface of the trunnion cooperates with a conventional bushing or bearing **93**, three of which are utilized in the preferred embodiment for rotary movement of the container assembly therearound. End plate **50** is designed for abutting engagement with push block **90** in the fully open position as shown in FIG. **4B** while FIG. **3** illustrates engagement with push block **88** in the closed position.

Further, a cam follower **94** extends axially outward from each end plate **48, 50** toward respective gears **60, 62**. The cam follower **94** of each end plate is designed for receipt in each cam slot **68** of the inner face of drive gears **60, 62**. The cooperating end plates and gears define a means for imparting generally arcuate movement and generally radial movement of the door as will be detailed below. More particularly, the cam slot **68** and cam follower **94** define a cam means for actuating movement of the door. Each cam follower includes a high-density, self lubricating member **96** peripherally arranged on the cam follower to facilitate sliding/rolling contact with the cam slot.

Further, an elongated generally rectangular aperture **102** is provided in each of the end plates and slidingly receives a slide block **104** therein. Once again, description of the right-hand end plate **50** is equally applicable to the structure of end plate **48** unless particularly noted otherwise. Preferably, the slide block **104** and elongated aperture **102** have a cooperating tongue and groove arrangement **106** adapted for ease of radial movement of the slide block relative to the end plate. The slide block **104** has a central aperture **108** with bearing **93** designed for rotative mounting on trunnion **92**. The end plate **50** also includes plural door locking slots **110, 112, 114**, and **116**. The door locking slots are peripherally arranged on the end plate and adapted for alternately receiving the combination push dogs/door locks **84, 86** therein. Further, closing member **120** is positioned at the base of the end plate **50** at an area distally arranged from the elongated portion **46** of the door.

In mounting the door onto trunnion **92**, the slide block **104** is initially positioned on the trunnion adjacent head end **36** of the container. Next, the end plate **50**, with the closing member **120** removed therefrom, is radially positioned over the slide block. The cooperating tongue and groove engagement between the slide block and end plate facilitate ease of mounting. The closing member **120** is thereafter secured to the end plate to limit the radially outward movement of the door relative to the container **30** if the cam means fails. Otherwise, the cam slot and cam follower limit radial outward movement of the door. The closing member also reinforces the end plate and retains alignment of the tongue/groove arrangement **106**.

During operation of the door, the slide block remains stationary relative to the trunnion and rotates with the door. Nevertheless, the remainder of the end plate **50** undergoes radial inward and outward movement relative to the slide block as a result of the cam actuated movement. In this manner, the door **44** moves from a radially outer open position (see FIG. **4B**) to a radially inner closed position (see FIG. **6B**).

As indicated above, the push blocks **88, 90** are peripherally arranged on head **36** of the container assembly. More specifically, the circumferential arc length between the push blocks **88, 90** is approximately twice the width of door **44**. Thus, in the illustrated open position of FIGS. **4A** and **4B**, the aperture **40** is completely exposed and end plate **50** is in abutting engagement with push block **90**.

It is also noted that in the open position of the door, the head end **36** includes a radially recessed portion **122** (FIG. **3**) adapted to receive the elongated portion **46** of the door therein. As will become more apparent, this assures a compact arrangement of the door with the container **30** in an open position and further prevents any interference with the drive shaft **16** or other portion of the support structure. This also provides compactness of the entire container assembly.

Turning now to FIGS. **4A** and **4B**, the open position of the door relative to the container and, specifically, aperture **40** will be described in detail. This is also known as the load position of the container assembly in which the aperture **40** is generally facing angularly upward for receipt of particulate workpieces therein. This position also assists an operator in viewing the loading of the container. The door **44** abuttingly engages push block **90** and is positioned at a radially outer position i.e., the slide block is closely adjacent the closing member **120** in end plate **50**. Further, the combination push dog/door lock **86** is received in the door locking slot **110**. Similarly, the combination push dog/-door lock **84** is received in door locking slot **114**. A counterclockwise movement of the gear **60** will release the door from abutting engagement with the push block **90**. More importantly, the cam follower **94** is received in the constant radius portion **70** of the cam slot. The cam slot and cam follower of the gear and door, respectively, provide for relative positioning both radially and arcuately between the container and door.

In the open position, the container is loaded with particulate workpieces through aperture **40**. The aper-

ture is sufficiently large to permit quick loading of a large number of workpieces. The specific loading mechanism forms no part of the subject invention and further discussion is deemed unnecessary to a full and complete understanding of the invention.

With reference to FIGS. 5A, 5B, and 5C intermediate closing positions of the door relative to the container are shown. More specifically, counterclockwise movement of the drive gear as illustrated in FIG. 5B will advance the cam follower to the crest portion 74 of the cam slot. During this portion of the movement, the drive gears rotate relative to both the door and the container. At this point, further counterclockwise rotation of the gears will, in turn, rotate the door away from push block 90 and toward engagement with push block 88 due to abutting engagement between the cam follower 94 and crest portion 74. The continued counterclockwise rotation is defined by simultaneous movement of the drive gears and door and both members rotate relative to the container. Upon engagement of the door with push block 88, cam follower 94 advances radially outward over the crest portion of the cam slot. Accordingly, the door moves radially outward with respect to the container. The door is centered over the aperture 40 and will next undergo a radially inward movement.

Further counterclockwise rotation of the gears as shown moves the cam follower through the radially varying portion 76 of the cam slot. Associated with this action, is the radially inward movement of the door toward the aperture 40. Likewise, the combination push dogs/door locks 84, 86 continue to move away from door locking slots 110, 114 and toward the door locking slots 112, 116 (FIG. 5C). Once the cam follower has reached a predetermined position in the radially varying portion 76 of the cam slot away from the crest portion 74 the combination push dogs/door locks 84, 86 abuttingly engage the new pair of door locking slots 112, 116. Thus, as illustrated in FIGS. 6A and 6B the door has moved radially inward into a seated position and covers aperture 40. Any further counterclockwise movement of the gear provides simultaneous rotation of the door and the container together. This would correspond to the loaded condition of the container assembly in which it undergoes a submersion and tumbling or cascading of the workpieces retained in the work cavity.

Upon completion of the predetermined duration in the treatment tank, the container is locked in place and removed from the tank. Further rotation in a counterclockwise direction orients the container essentially as shown in FIG. 6B. The drive gears are now rotated in a clockwise manner as shown until the door opens relative to the aperture in a reverse manner from that described above. The door moves radially outward as the cam follower 94 proceeds through the radially varying portion 76 of the cam slot toward the crest portion. Once the cam follower reaches the crest portion 74 of the cam slot, the gear and door rotate together away from push block 88 and toward push block 90. Upon abutting engagement with the push block 90, the cam follower passes over the crest portion and into the constant radius portion 70 of the cam slot. Accordingly, during this procedure the combination push dogs/door locks 84, 86 have also moved from engagement with locking slots 112, 116 to the locking slots 110, 114. At this point, the aperture is completely uncovered and further clockwise rotation, as shown, of the cylindrical container 30 provides for emptying the contents from the work cavity. That is, the aperture is rotated in a clockwise direction until it faces downwardly. Once the contents are emptied, the clockwise rotation continues until the aperture is positioned in an angularly upward position for the next loading of workpieces (FIG. 4A).

As is apparent from the above description, an operator of the plating container 30 can be located in a "hands-off" position where he is safely clear of the loading and unloading operation of the barrel. There is no requirement for any manual contact with the door and the radially inward movement of the door with respect to the aperture eliminates any gaps therebetween and prevents any particulate workpieces from falling out. This arrangement also eliminates any need for springs or clamping arrangements to retain the door in a closed position with the aperture. The motor is only required to be of the reversing type and no special controls are required. The complete opening and closing action of the door is governed by the rotation of the gears and the cam follower tracking in the cam slot along with the door and push block engagement as well as the combination push dog/door lock and end bracket engagement. Further, only the weight of the door is loaded on the cam follower and cam slot.

Referring now to a modified door as illustrated in FIG. 7, and for ease of illustration, like elements are identified by like numerals with a primed (') suffix and new elements are defined by new numerals. The modified door 44' includes an elongated portion 46' that is reinforced through use of encapsulated strengthening members 52' that extend along the longitudinal length of the door. Opposed end plates 48', 50'are disposed in a generally perpendicular relation with respect to the elongated portion 46'. A cam follower 94' extends axially outward from each of the end plates 48', 50'. In much the same manner as described above, the cam follower 94' of each end plate is designed for cooperating relation with an inwardly facing cam slot on an interior face of opposed driven gears, only one of which is shown for ease of illustration. In the preferred embodiment of FIGS. 1–6, an elongated aperture received a slide block therein for permitting radial movement of the door with respect to trunnion 92. The preferred arrangement is designated for extreme wear conditions so that the wear resulting from the radially inward and outward movement of the door is dispersed over the tongue and groove arrangement of the slide block and end plate.

In the modified arrangement of FIG. 7, an elongated aperture 102' is defined in each of the end plates and adopts a generally elliptical configuration or any conforming slot with rounded corners. The minor diameter of the ellipse generally conforms to the outer diameter of raised portion 122 of the drive gear 62'. In this manner, wear between the relatively moving parts is not distributed over as great a surface area. Nonetheless, this arrangement is more than satisfactory for most industrial applications and significantly decreases the complexity as well as machining and assembly costs. The end plates still utilize plural door locking slots 110', 112', 114', and 116' and encapsulated steel reinforcement 52'. In all other respects, the modified door arrangement of FIG. 7 functions in approximately the same manner as that described with the preferred embodiment of FIGS. 1–6.

The trunnion 92 is particularly illustrated in FIG. 8 and, as described above, is fixedly mounted to a support

hanger arm **12** or **14**. As illustrated, the trunnion has a generally cylindrical configuration with an aperture extending generally longitudinally therethrough. The aperture **124** is centrally positioned at a first or outer end **126** but is eccentrically disposed at a second or inner face **128**. The trunnion aperture is designed to receive a dangler therethrough. The dangler will thereby maintain a generally downwardly angled configuration and not migrate appreciably upward with workpieces during rotation of the container, notwithstanding virtually constant impinging contact with the workpieces.

As is well known in the art, when used for electroplating the danglers are provided to supply the high current or throwing power necessary to effect plating of the workpieces. An electric current induced through the danglers charges the workpieces through contact therewith. As the container is rotated, the workpieces to be plated are continuously exposed to a relatively uniform high current field by repeated rotation and exposure to one of the danglers or by conduction through other workpieces. The presence of the electric current causes migration of the plating ions to the workpieces. If the danglers are not required, a blind trunnion may be utilized.

Turning now to FIGS. **9** and **10**, the advantageous arrangement of the door with respect to the aperture will be described in greater detail. The elongated portion **46** of the door is of notched design so that it fully seats within the aperture **40**. As shown in FIG. **9**, a pair of axially extending door ribs **140, 142** receive two perforated panels **144, 146** defining a portion of the container sidewall. The ribs each define a recessed step portion **148, 150** that, in turn, matingly receives a stepped lower surface **152** of the door. In a fully closed position, the step portions **148, 150** abuttingly support the door so that particulate workpieces in the container are retained therein.

Similarly, and with reference to FIG. **10**, the door elongated portion **46** also includes an axial step surface **154** that closely accommodates a head end. The stepped, mating configuration facilitates retention of the workpieces in the work cavity.

Yet another advantageous feature is provided by the subject invention. Referring now to FIG. **11–13**, the dumping sequence of the container is shown. In FIG. **11**, the container has completed the treatment process of the workpieces W and the aperture **40** is positioned in an angular upward loading position. The door opening process is completed and further clockwise rotation of the container as shown orients the aperture in a downward position. As particularly detailed in FIG. **12**, the workpieces have a tendency to "climb" along the left-hand portion of the work cavity as rotation of the container continues. The workpieces tend to exert a counterclockwise torque or rotation on the container which is opposed to the clockwise rotation of the gear. Thus, the combination push dogs/door locks tightly engage the door locking slots **110, 114** and the end plate abuts push block **90**.

The sequence of FIGS. **14–16** depicts the tumbling action of the workpieces once the container has been loaded, the door closed over the aperture, and the container rotated in a counterclockwise direction as shown for treating in a treatment tank. During the counterclockwise rotation, the workpieces migrate up the right hand side of the work cavity thereby imposing a clockwise torque or rotation on the container. The shift in weight to an uneven distribution eccentrically positions the centroid of the workpieces toward the right hand portion of the container in relation to the axis of rotation defined through the trunnion. The combination push dogs/locking pins now tightly engage the door locking slots **112, 116** and the end plate abuts push block **88**. Thus, as is apparent, the open position and the closed position of the door is enhanced by the force and torque exerted by the workpieces.

The invention has been described with reference to the preferred and modified embodiments. Obviously modifications and alterations will occur to others upon a reading and understanding of this specification. It is intended to include all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

Having thus described the invention, it is now claimed:

1. A rotatable container assembly for use in the surface treatment of particulate workpieces selectively enclosed therein, said container assembly comprising:
- a container having opposed head ends held in spaced relation by a side member and defining a work cavity therein;
- an aperture formed in a minor portion of said side member for ingress and egress to said work cavity;
- a door for opening and closing said aperture; and,
- means for imparting generally arcuate movement and generally radial movement to advance and retract said door between a first open position and a second closed position relative to said aperture.

2. The container assembly as defined in claim **1** wherein said movement imparting means includes a cam slot and a cam follower.

3. The container assembly as defined in claim **2** wherein said cam slot and cam follower actuate said door from said first open position through a first generally arcuate path and then through a second generally radial path to said closed position.

4. The container assembly as defined in claim **1** wherein said container remains generally stationary during advancement and retraction of said door.

5. The container assembly as defined in claim **1** wherein said movement imparting means includes a gear having a cam slot defined thereon.

6. The container assembly as defined in claim **5** wherein said movement imparting means includes a cam follower on said door for operative engagement with said cam slot.

7. The container assembly as defined in claim **1** wherein said door and at least one of said opposed head ends include means for selectively retaining said door and container in fixed relative position.

8. A rotatable container assembly for use in the surface treatment of particulate workpieces selectively enclosed therein, said container assembly comprising:
- a generally cylindrical container having opposed head ends held in spaced relation by a generally curvilinear side member and defining a work cavity therein;
- an aperture formed in a minor portion of said side member for ingress and egress to said work cavity;
- a door for opening and closing said aperture; and,
- cam means for actuating movement of said door relative to said aperture.

9. The container assembly as defined in claim **8** wherein said cam means imparts a generally arcuate movement to said door.

10. The container assembly as defined in claim 8 wherein said cam means imparts a generally radial movement to said door.

11. The container assembly as defined in claim 8 wherein said cam means imparts both a generally arcuate movement and a generally radial movement to said door.

12. The container assembly as defined in claim 8 wherein said door includes means for allowing generally radial movement while remaining operatively connected to said container.

13. The container assembly as defined in claim 8 further comprising door locking means adapted for selectively maintaining said door in open and closed positions.

14. The container assembly as defined in claim 8 wherein said door includes a generally longitudinal portion adapted for covering relation with said aperture and a door end plate operatively engaging said container.

15. The container assembly as defined in claim 14 wherein said end plate includes means for allowing generally radial movement of said door.

16. The container assembly as defined in claim 15 wherein said radial movement means includes an elongated cutout adapted for sliding engagement with a trunnion fixedly engaged to said container.

17. The container assembly in claim 15 wherein said radial movement means includes an elongated cutout operatively receiving a slide block therein, said slide block adapted for sliding engagement with a trunnion operatively associated with said container.

18. The container assembly as defined in claim 14 wherein said cam means includes a cam follower operatively disposed on said end plate.

19. The container assembly as defined in claim 18 wherein said cam means further includes a gear having a cam slot defined therein and adapted to receive said cam follower.

20. The container assembly as defined in claim 14 further comprising door locking means adapted for selectively maintaining said door in open and closed positions.

21. The container assembly as defined in claim 20 wherein said locking means includes door locking slots peripherally arranged on said door end plates.

22. The container assembly as defined in claim 21 wherein said locking means further includes a gear having a lock member extending therefrom and adapted for alternate operative engagement with selected door locking slots.

23. The container assembly as defined in claim 8 wherein one of said head ends includes first and second push blocks disposed thereon and adapted for engagement with said door to selectively rotate said container with said door.

24. The container assembly as defined in claim 8 wherein one of said head ends includes a reduced dimension peripheral portion adapted to receive said door in an open position.

25. The container assembly as defined in claim 8 wherein said door includes a generally longitudinal portion adapted for covering relation with said aperture and first and second door end plates extending generally perpendicular from opposed ends of said longitudinal portion and operatively engaging said container.

26. A rotatable container assembly for use in the surface treatment of particulate workpieces selectively enclosed therein, said container assembly comprising:

a generally cylindrical container having cylinder head ends retained in axially spaced relation by a sidewall and a work cavity defined therein;

an aperture formed in a minor portion of said sidewall for ingress and egress to said work cavity;

a door including an elongated portion adapted for selective covering relation with said aperture and a door end plate extending generally perpendicular from said elongated portion and operatively engaging said container; and,

a gear in facing relation with said end plate, said gear including one of a cam slot and cam follower cooperating with the other of said cam slot and said cam follower on said end plate and adapted to impart arcuate and radial movement to said door for selective covering of said aperture.

27. A container assembly as defined in claim 26 wherein said end plate includes a cutout adapted for sliding, radial movement relative to a trunnion operatively associated with said container.

28. The container assembly as defined in claim 27 wherein said end plate includes peripherally arranged door locking slots adapted for alternate operative engagement with a lock member extending from said gear wheel.

29. The container assembly as defined in claim 28 wherein one of said head ends includes first and second push blocks disposed thereon and adapted for engagement with said door to selectively rotate said container and door together.

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